BASICS

> There is nothing more desirable than good sense, and accuracy of thought, in discriminating between truth and falsehood. All other qualities of mind are of limited use; but exactness of judgment is of general utility in every part, and in all the employments of life.
>
> *Port-Royal Logic* (1662)

[1]

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BASICS

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1 The *LCR*: What

The London Close Reasoner is a publication dedicated to promoting good sense and accuracy of thought, which is to say, it aims to help its readers become close reasoners. Loose reasoning is the enemy, and is attacked at every opportunity.

As a publication, the *LCR* exists currently as a confusing assortment of what, lacking a better term, we shall call modules. They appear sporadically in a variety of versions and editions in photocopied form. The whole thing is currently under development, and it is to be hoped that a more orderly and intelligible arrangement will have been found by the time it is done.

Some of the modules are like chapters of a text book, others collections of exercises, still others collections of supplementary materials of various sorts, word lists, instructive passages, summary sheets, etc. In a different category belong units that are like issues of a newspaper or magazine in which examples of reasoning from the past and present are closely examined.

Loose reasoning is the enemy, and is attacked at every opportunity.

In so far as possible, these modules are intended to be independent of each other so that they can be read in any order, so that some of them can be skipped entirely, and so that, indeed, any one of them will stand by itself. This is done even at the cost of some repetition of material.

The present module, however, along with a few others, is an exception; it is presupposed by all the rest. The key concepts that are used over and over again in the others modules are introduced and explained here.

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[1] Il n'y a rien de plus estimable que le bon sens & la iustesse de l'esprit dans le discernement du vray & du faux. Toutes les autres qualités d'esprit ont des vsage bornez; mais l'exactitude de la raison est generalement vtile dans toutes les parties & dans tous les emplois de la vie. (Antoine Arnauld and Pierre Nicole, *Logic, or The Art of Thinking*, otherwise known as *The Port-Royal Logic*, 1662, p. 5. The translation is by Thomas Baynes, 1850, p. 1.)

We may think of ourselves as explorers in the realm of reasoning, and this module resembles our base camp. Every day we set out from here in a new direction to reconnoiter some new territory, and we return here every night to assess what we have discovered.

2 Close reasoning: What

Reasoning is the process of adjusting thoughts so as to make them more rational; noy just single thoughts, but systems of thoughts, or thought structures. **Close** reasoning observes a very high standard of rationality in doing this; **loose** reasoning is satisfied with a low standard, or none at all.

Reasoning is the process of adjusting thoughts so as to make them more rational.

That is reasoning as it goes on in the individual; we call it **private** reasoning. There is also such a thing as **public** reasoning; this occurs when one person reasons with another, and several people may find themselves adjusting their thoughts.

2.1 Reasoning and inference

This is a broader conception of reasoning than one usually finds in books on reasoning and logic, where the word tends to be limited to the special case of inference. **Inference** is the process in which, being committed to certain ideas, you go on to accept further ideas because it would be irrational to cling to the old ones without adding the new.

But wherever inference occurs[2] there is the option of rejecting the new idea and preserving rationality by abandoning some of the old. Choosing between these options would be a kind of reasoning, as we use the term here, but not inference. For the **LCR**, reasoning includes more than inference.

But, for all that, inference is still the most important form of reasoning, and since it will receive the major part of our attention, we will not be departing all that much from the standard books.

2.2 Thoughts

We mean to count as thoughts anything that might go on in your head that could be the target of rational criticism. This includes your beliefs and opinions, your ideas and concepts, your wishes, desires, preferences, your intentions and plans of action, even your attitudes, emotions and feelings, your moral convictions and principles, your articles of faith. All of these things can be looked at from the point of view of rationality[3].

This is also a broader view of rational thought than is to be found in the majority of books on this subject. The tradition has been to concentrate on beliefs and opinions, and, at the level of language, on propositions or statements, which is what you get when you express a belief or opinion in words. The attitude of Aristotle is typical:

> "We call propositions those [sentences] only that have truth or falsity in them. A prayer is, for instance, a sentence but has neither truth nor falsity. Let us pass over all such, as their study more properly belongs to the province of rhetoric or poetry."[4]

Of course, we must acknowledge the importance of having true and rational beliefs and opinions, and this is our major concern. But we must not forget the importance of rationality in other areas.

A prayer, for example, **can** be criticized from the point of view of rationality, as when the King in *Hamlet* tries to pray for forgiveness, though unwilling to give up the gains for the sake of which he committed the act, and unable to repent.

> My fault is past. But O, what form of prayer
> Can serve my turn? 'Forgive me my foul murder?'
> That cannot be, since I am still possess'd
> Of those effects for which I did the murder,
> My crown, mine own ambition and my queen.
> May one be pardon'd and retain the offence?
> ...
> Try what repentance can: what can it not?
> Yet what can it when one cannot repent?[5]

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[2] Except in the trivial case of inferring from truths of logic, about which a little more later.

[3] Many people would say that some of these things **shouldn't** be looked at from that point of view even if they could be. Romantics are leery of trying to apply reason to emotion, and the religiously devout often oppose the application of reason to faith, for example. These are important philosophical issues to be examined in some other module.

[4] Aristotle (384-322 B.C.), *On Interpretation*, 17 a 4. The translation is by Harold Cooke in the Loeb series.

[5] Shakespeare, *Hamlet* (1602?), act III, scene iii.

Intentions can be irrational, as when I intend to reach a certain goal without intending to do the necessary work. Emotions can be irrational, as when I continue to be angry with my friend after I learn that she did not in fact do the thing that I was angry at her for. My faith can be irrational if, say, I hold that there is just one supernatural being, and at the same time believe in both God and the Devil.

The most glaring form of irrationality is flat out self-contradiction.

In all these cases, and in others like them, there is room for adjustment of thoughts to make them more rational

2.3 Rationality

In reasoning we try to make our thoughts more rational, and in close reasoning we set high standards. But what is rationality, exactly, and what are these standards?

This is a surprisingly difficult question, and we cannot event attempt a full answer here. If you pursue this question earnestly you will be led deep into several branches of philosophy, and you will have to study other fields as well, such as economics and mathematics, not to mention formal logic.

Even so, the *LCR*, without going that far, will in these studies go some distance towards explaining what rataonality is. Indeed, every one of the modules will seek to add to our understanding of that notion.

Here at the outset the most we can expect is a working definition, something around which to organize ideas as the inquiry proceeds. We provide that by starting with the negative; **rationality**, we say, is the avoidance of irrationality. And we explain **irrationality**, to a degree, by pointing to examples.

The most glaring form of irrationality is flat out self-contradiction; I hold that all sinners should be forgiven and also that some sinners are beyond forgiveness. This one is pretty obvious, but contradictions can take subtle and intricate forms, and it is surprising how much of rationality consists simply in avoiding contradiction. The whole of formal logic, it turns out, is based on that.

Another form of irrationality arises when the strength of my belief is not in proportion to that of the evidence upon which I base it. In 1981, for example, the Reagan administration in the U.S. became convinced, on the basis of slim evidence, that the communists were using a poison weapon, "Yellow Rain", in Asia, and made strong public statements about it; it is now known, at least to everyone else, that these accusations were false[6]. We will learn something about this form of irrationality when we study inductive logic, probability, and related topics.

Still another form has to do with desires and preferences. Suppose I'd rather party than study, and I'd rather study than clean house, and yet, given a choice between partying and cleaning house, I choose to clean house. There seems to be an irrationality or incoherence here in my system of values. This kind of thing will be considered under the general heading of decision theory.

In all the areas where we can criticize thoughts on the grounds of irrationality it is possible to find standards of rationality, some more demanding than others. In some areas, such as mathematical logic, these standards are clear cut, though somewhat complicated. In others, such as the acceptance of new scientific theories, they are less definite, and there is disagreement among the experts about details.

In still other areas, such as our most basic values, there is dispute whether there even are any standards of rationality, and so, whether rational criticism is really possible. We take this as a sign that there are limits to the power of reason, though it is not clear where those limits lie. But close reasoners go as far as they can in pursuit of rationality, and push against the limits.

Another form of irrationality arises when the strength of my belief is not in proportion to that of the evidence upon which I base it.

2.4 Adjusting thoughts

Reasoning, we have said, is a process

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[6] The August 31, 1987 issue of *The London Free Press* carries a report on p. A12 of an article documenting this in the fall 1987 issue of the journal *Foreign Policy*.

of adjusting thoughts; what sort of adjustment do we have in mind?

Well, any kind, really; whatever it takes to make your thoughts more rational, not just single thoughts but your whole system of thoughts.

On occasion you may want to take out your ax and go to work in a big way. You may totally abandon certain beliefs, or take on new beliefs; you may change your politics from the ground up. You may change your attitude towards a certain person and seek a divorce. You may join, or quit, a church.

The famous philosopher and scientist Descartes (1596-1650), for one, was a believer in the radical approach. He recommended a sort of total house cleaning in which you throw out all of your beliefs that are in any way doubtful. This means that you strip your thinking down to the bare minimum, which for Descartes is the point at which the only thing you know is that you are thinking, and so exist. This is his famous "*cogito ergo sum* — I think, therefore I am." After you reach that point, according to the plan, you bring back old beliefs, or replace them with new ones, being very careful in every case to make sure that the belief has an absolutely solid basis.

We will not be recommending such drastic measures. In the majority of cases it is quite enough to do the adjusting on a smaller scale; we do not totally abandon a belief, but we add qualifications to it, or modify our degree of confidence in it. We draw distinctions, and separate out things that we used to lump together. We suspend judgment and seek further evidence before making up our minds. We take note of risks, and prepare some contingency plans before leaping into action. But this is not to deny that sometimes major overhauls are required.

> If it gets really bad, see your psychiatrist.

It happens occasionally that people get into a situation where it is reasonably clear what adjustment is required, but they find themselves quite unable actually to make that adjustment. There are people who know perfectly well that garter snakes are harmless, but are quite unable to put this belief into practice by taking the snake into their hands. Often this is because strong emotions are involved, either in the present or in the past. The *LCR* will not be much help with that problem; if it gets really bad see your psychiatrist. Our aim is merely to help with the easier task of discovering what changes ought to be made.

2.5 Public reasoning

Private reasoning is more fundamental than public reasoning since, in the end, we each have to make up our own minds regardless of what others think, say or do. Yet public reasoning exists, and is tremendously important, and a great deal of our reasoning consists in trying to play our part, as best we can, in public reasoning of one sort or another.

Public reasoning has traditionally been an important component of logical studies, and it will occupy a major part of our attention. Here we distinguish three main types of public reasoning: dialogue, debate and presentation, without in any way suggesting that this exhausts the list.

> **"It is maintained", says the subtle Scaliger, "by Vives, that we profit more by silent meditation than by dispute. This is not true. For as fire is elicited by the collision of stones, so truth is elicited by the collision of minds. I myself frequently meditate by myself long and intently; but in vain; unless I find an antagonist, there is no hope of successful issue."**[7]

2.5.1 Dialogue

Dialogue[8], in our sense, is the kind of public reasoning in which two or more persons co-operate in reasoning. Through discussion, they help each other to become more rational about some issue.

The *LCR* considers dialogue to be the ideal form of public reasoning, and attaches great value to it. Engaging in it is perhaps the single most important method by which we improve our rationality.

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[7] William Hamilton, *Lectures on Logic*, 1860, p. 481. Julius Scaliger (1484-1588) and Juan Luis Vives (1492-1540) were leading scholars of their times. Hamilton quotes from Scaliger's *Exertationes*, p. 420.

[8] "**Dialogue** is not necessarily the talk of **two persons**; it means conversation as opposed to monologue, to preaching, lecturing, speeches, narrative, or description; see DUOLOGUE." (Fowler, *Modern English Usage*, p. 128). The trouble is that some people confuse the prefix "dia" of "dialogue", which means *across* or *through*, with the prefix "di", which means two.

The reason for its usefulness lies in the fact that our reasoning powers are sadly limited, but our limitations can in some measure be overcome with the help of others. "Two heads are better than one" is the appropriate slogan, and it states a profound truth.

Dialogue, or perhaps we should say true dialogue, is public reasoning entered into in this spirit. It is a co-operative endeavour aimed at coming jointly to the most rational conclusion, and is marked by sincerity, openness and helpfulness, and by intelligent listening as well as speaking.

And it almost never occurs in its pure form; Ego gets in the way. We forget that the aim is to discover the truth, and we aim merely to win the argument. Or we seek simply to show off our cleverness. Still, we often come close to true dialogue, and our approximations are always valuable. They become more valuable when the rules and methods of close reasoning are employed.

2.5.2 Debate

Debate can take many forms; the common feature is that two or more participants propose, and seek to establish and maintain opposing views about some issue. Usually this is for the benefit of a non-participating judge or audience, since the debaters do not really expect to persuade each other. The goal is to stand firm and hold your ground, and to make it appear that you are right and your opponent wrong; to be persuaded by another debater would be to lose the debate.

No one neeeded a parlor maid with debating skills.

Sometimes debating can be a mere academic exercise, but it is also a vitally important activity in many parts of life. Our adversarial system of law is built on it; two sides debate for the benefit of judge and jury. It is also central to the operation of parliaments, and of the countless other deliberative bodies characteristic of a democratic society.

The importance of debating in public life has always been recognized, and one of the main motives for the invention, teaching and study of logic was to prepare people to engage more effectively in it. In past centuries this was intended chiefly for young men of the upper classes, who alone had need and opportunity to debate. (No one needed a parlor maid with debating skills.)

The ***LCR*** also values debate, and has suggestions to make about the proper conduct of it, both for participants and for the audience. And it advises the close reasoner to be wary when involved in any way with debate; the debater is not out to help, as in dialogue, but to win or convince, and we must be on our guard.

2.5.3 Presentation

In dialogue and debate there is give and take. But there is also a one-way form of public reasoning in which there is a 'sender' and a 'receiver', and they do not change roles. We will call this **presentation**.

When we deal with presentations, we are usually on the receiving end. This happens when we read books, magazines or newspapers in which reasoning is presented, or when we encounter reasoning on television or radio. But even though we cannot answer back, the techniques of close reasoning are very valuable in helping us to grasp the true meaning of a presentation, and to assess it properly.

Skill in close reasoning is also helpful to the presenter, though historically logic has tended to turn this topic over to the sister science of rhetoric.

3 Close reasoning: Why

It should be pretty obvious why close reasoning is important. *The Port-Royal Logic*, quoted at the beginning of this module, had it about right. With close reasoning you are more likely to find the truth, and to decide upon the right course of action. Also, as a close reasoner, you are more likely to help those with whom you associate to do the same thing. And it is essential that you be a close reasoner if you are properly to perform your many public roles in a democratic society.

We can look at this last point from the other side. It is important to the rest of **us** that **you** reason closely when you act in our democratic society. Democracy depends on the good sense of its citizens, and collapses when that good sense goes off track, or is overwhelmed by passion. The

**It is important to the
rest of US that YOU
reason closely.**

history of Europe in the 1930's is an illustration of that.

Nor is close reasoning as widespread in our society as we could wish. Yesterday's paper[9] carries the story of a professor writing a grade 12 text book on astronomy for use in Ontario schools who was asked to replace the word "evolution" by "change" or "development" when describing the history of the universe. Said the professor,

> "The person involved said that if he used the word 'evolution' he would get 600 letters from Creationists, and they [the Ministry of Education] would have to deal with this and they have better things to do with their time,"

And a spokesman for the ministry explained that they are sensitive to the passions stirred by the word "evolution",

> "... just like the word 'abortion' raises hackles."

So the loose reasoning of the Creationists is to keep young people from learning mainstream scientific terminology. (This may be gone into in more detail if and when the module on scientific reasoning is written.)

The same paper had a story about the Jehovah's Witness cult, and the misery experienced by individuals whose reasoning leads them to leave it, and who are then cruelly 'shunned' by family and former friends still in the cult. Irrational beliefs do not harm only the ones who have them. (This may be gone into in more detail if and when the module on religious fundamentalism is written.)

Elvis' Ghost Helped Cop Find His Runaway Son
(National Enquirer, Sept. 1, 1987, p. 44)

And the radio news tells of Matilda township in eastern Ontario, which has declared itself officially English to forestall what is there perceived to be a creeping francophone *coup d'etat*. Loose reasoning generates unreasonable fear, which generates foolish and mean-spirited action. (This may be gone into in more detail if and when the module on reason in a democratic society is written.)

It is very likely that the general level of reasoning is higher now than in previous ages, when education was restricted to a much smaller segment of the population. But that is no ground for smug satisfaction. The *National Inquirer* still publishes, and claims to have the "largest circulation of any paper in America." Respectable newspapers still carry horoscopes. Wintario lottery tickets are still purchased. Question Period in Parliament still is as it is. Students still pay large fees to come to university and then cut class.

4 Logic

There is an intimate relation between the study of close reasoning and the study of logic; indeed, as we shall use the words, logic will form a part but not the whole, of the study of close reasoning.

There is some confusion about the word "logic", and we will first clear that up. Then we will present some of the technical terminology of formal logic, which will prove to be very helpful to the close reasoner.

4.1 Logic: the word

Our word "logic" comes from the French "logique", which has existed since the 13th century. It went through a variety of spellings in English before settling down to the present one late in the 18th century.

French got it from the medieval Latin "logica", which was short for "ars logica", the logical art, or the art of reasoning. This was a rendering into Latin of the Greek "he logikè téchne", the earliest known occurrence of the Greek word is in Cicero (106-43 B.C.), who is writing in Latin about Greek philosophy:

> "Turn next to the second division of philosophy, the department of method and dispute, which is termed *Logikè*."[10]

This is a form of the Greek adjective "logikós" — pertaining to reasoning — which in turn comes from the noun "logos", which covered a spread of meanings: word, oration, reason, reasoning, etc. That word is, among other things, the source of the "logy" ending in words such as "psychology".

Logic, in the most extensive sense which the name can with propriety be made to bear, may be considered as the Science, and also as the Art, of reasoning. It investigates the principles on which argumentation is conducted, and furnishes rules to secure the mind from error in its deductions. (Whateley, 1826[11])

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[9] *The Globe and Mail*, Toronto, July 25, 1987. This day was in no way remarkable in its supply of loose reasoning.

[10] *De Finibus Bonorum et Malorum*, I.vii.22. Translation revised.

[11] Richard Whateley, Elements of Logic, p. 25.

The adjective was also used by Cicero in the neuter plural, "tà logikà", which led to the form "logics" in English, analogous with "ethics" and "mathematics", but this died out in the 18th century.

So "logic", by tradition, means "the art of reasoning", but the situation in the present day is not so simple; here is the *Oxford English Dictionary*, with its head just barely above water:

> The proper scope of this department of learning has been and is much controverted, and books on 'logic' differ widely in the range of subjects which they include. ... At all times the vulgar notion of 'logic' has been largely that it is a system of rules for convincing or confounding an opponent by argument.[12]

4.2 Logic: the subject

But there is a very clear meaning of the word current today in philosophical and scientific circles, and the ***LCR*** proposes to follow that usage. It is suggested by the following passage from a standard text book by Kalish and Montague:

> The expressions 'logic', 'formal logic', 'symbolic logic' and 'mathematical logic' are in the just acceptation synonyms. They refer to a discipline created by Aristotle, extended by the Stoics, studied by the Scholastics, developed in the esoteric writings of Leibniz, and sent on its modern career in the late nineteenth century.[13]

This kind of logic is formal because it only pays attention to the form of the reasoning and ignores the subject matter. It is symbolic because it uses a special symbolic language, rather like that of algebra, to represent the forms. It is mathematical partly because it uses methods like those of mathematics for calculating with these symbols, and partly because, at its more advanced levels, it merges with mathematics, and provides a part, at least, of the foundation for that discipline.

This subject has made formidable strides in the 20th century, with many notable discoveries. The more elementary parts are widely taught in university philosophy departments, and sometimes in departments of mathematics; the more advanced parts are dealt with in graduate schools. The subject contains a hard core of doctrine called standard or classical logic, as well as a number of nonstandard extensions and alternatives, which need not concern us here.

From a practical point of view, what logic in this sense mainly has to offer the close reasoner are ways of representing the logical forms of various kinds of statements and arguments, and ways of determining, by a sort of calculation, whether the argument forms are valid. "valid" is here understood in the sense of "deductively valid"; the form of the argument is such that the premises, if true, absolutely guarantee the truth of the conclusion.

This can be very useful, and the ***LCR*** will include some modules on some of the elementary parts of it, as well as on 'Aristotelian' logic, an earlier stage in the tradition mentioned by Kalish and Montague.

But formal logic is not to be identified with our study of close reasoning; it is only a part of it, just one among the many tools that we want to have available. We will discuss the advantages and limitations of formal logic in the modules that deal with that subject.

4.3 Logic: the vocabulary

One of the most useful things to be learned from formal logic is a precise vocabulary for discussing many items of concern to the close reasoner. We present some of that vocabulary here, though without aspiring to perfectly exact definitions. These terms will be used frequently in the other modules.

4.3.1 Possibility

Formal logic studies the **possibilities** for the truth and falsehood of propositions or statements. It is not concerned with whether statements actually are true or false, but only with whether they, or combinations of them, could possibly be true or false.

This is a special kind of possibility, called **logical possibility**. It is distinguished from other kinds of possibility, such as physical possibility. For example, it is logically possible but not physically possible that masses should be repelled rather than attracted by gravity.

As a rough statement of what logical possibility amounts to, though not a definition, we may say that a thing is logically possible if it doesn't lead by itself to contradiction, that is, doesn't lead to both affirming and denying the same thing.

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[12] *Oxford English Dictionary*, Compact edition, 1971, LOGIC. This entry is from the turn of the century, and the situation has only gotten worse.

[13] Donald Kalish and Richard Montague, *Logic: Techniques of Formal Reasoning*, 1964, p. ix

4.3.2 Truth value

Truth and falsity are said to be **truth values**, just as one, two, three, and so on are numerical values. They are the only truth values, as far as standard formal logic is concerned.

4.3.3 Propositions

A **proposition** or **statement** is a sentence of the kind that must have a truth value, and cannot have more than one truth value. There is some vacillation among logicians about the use of these terms; it depends on some fine points about the philosophy of language and meaning which need´t concern us here. But they all agree on the central point, that formal logic is concerned with entities that have and must have exactly one of the two truth values.

4.3.4 Negation

Propositions come in pairs, one true and the other false. The two members of the pair are said to be the **negations** of each other. You can form the negation of a proposition by incorporating the word "not", or some equivalent, into it. "It is not raining" is the negation of "it is raining". Sometimes the negation of a proposition is said top be its **contradictory**.

In standard logic the negation of the negation of a proposition is equivalent to the original proposition; double negation is the same as no negation at all.

4.3.5 Logical truth

When logic studies the possibilities for truth and falsity for propositions it discovers things such as the following:

Some propositions simply have to be true; there is no possibility of their being false. Such propositions are said to be **logically true**. "Either it is raining or it is not" is an example. Sometimes such a proposition is said to be a **tautology**, or to be **analytic**.

4.3.6 Logical falsehood

Certain other propositions are **logically false**; it is not possible for them to be true. "Snow is white and it is not" is an example. Such propositions are also said to be self-contradictory.

For reasons that are obvious if you think about it for a minute, if a proposition is logically true then its negation must be logically false, and *vice versa*.

4.3.7 Logical contingency

Still other propositions may possibly be true and also may possibly be false, as far as logic is concerned. They are said to be **logically contingent**. Most of the propositions that normal people are interested in fall into this category. "There will be a nuclear war before the end of the century" is an example. If a proposition is logically contingent then you need to know more than logic to determine whether or not it is true.

4.3.8 Logical consistency

Logic also studies combinations or sets of propositions. If it is possible for a set of propositions to all be true together, then the set is said to be **logically consistent**, and the propositions are said to be logically consistent with each other. If this is not possible, the set is said to be **logically inconsistent**. "The book is either red or blue", "the book is not red" and "the book is not blue" make up an inconsistent set.

Sometimes these terms are applied to single propositions rather than sets, but the meaning is essentially the same: consistent = possible to be true. In this usage, of course, an inconsistent proposition must be logically false.

4.3.9 Logical equivalence

Sometimes two propositions are related to each other in such a way that it is not possible for them to have different truth values; they must either both be true or both be false. Such propositions are said to be **logically equivalent** to each other. Double negation is an example of logical equivalence.

> **Virtue among arguments is known as validity. An argument is valid if it is impossible for its premises to be true and its conclusion false. But this is to speak loosely, and the reasonable do not countenance looseness. (Kalish and Montague, 1964)[14]**

4.3.10 Logical entailment

Sometimes a proposition is so related to a certain set of propositions that it is not possible for the proposition to be false when all the propositions of the set are true; the truth of the set forces the proposition to be true. The set is then

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14. Donald Kalish and Richard Montague, *Logic: Techniques of Formal Reasoning*, 1964, p. 3.

said to **logically entail** the proposition.

Sometimes this term is also applied to single propositions rather than sets, so that we can say that one proposition entails another. For example, "Not every philosopher smokes" entails "Some philosophers do not smoke".

4.3.11 Argument, Premise, Conclusion

Of particular interest to those looking for some relation between logic and real life is the structure of propositions called an **argument** (in the logicians' sense of the word; there are other senses). An argument is made up of a number of propositions called the **premises**[15] and a further proposition called the **conclusion**; these propositions make up an argument when the premises are advanced as proof of or evidence for the conclusion.

> **Formal logic deals only with certainties and impossibilities, with black and white.**

4.3.12 Validity

An argument is said to be **logically valid** when it is not possible for the conclusion to be false when the premises are all true. This is the same as saying that it is valid when the premises logically entail the conclusion. Or we could say that combining the premises with the negation of the conclusion makes an inconsistent set of propositions.

Finding out whether arguments are valid or invalid is the main business of logic, at least from the point of view of the close reasoner; the other matters are only important as means to this end If you have a valid argument, and if in addition the premises are true (these are different things) then you know that the conclusion must be true. If the argument is invalid, or if there is a false premise, then the argument is useless.

4.3.13 Deductive

The logic we are considering here is **deductive logic**; when it looks at an argument its only question is whether or not it is **possible** for the conclusion to be false when the premises are true. If this is possible then the argument is invalid, even though, outside of logic, the premises might be thought to give strong support to the conclusion — to make it very probable.

The whole question of how strong the evidence is, how well it supports the conclusion, how likely the conclusion and premises are to be true — all these matters, which are essentially questions od degree,lie outside the scope of deductive logic. Formal logic deals only with certainties and impossibilities, with black and white.

Some of these matters are dealt with by another discipline which sometimes goes by the name of **inductive logic**. That is another meaning of the word **logic**, and is considered in other modules. It too is very useful for the close reasoner.

5 Three strategies

Three approaches to problems, whose names are borrowed from computer science, will prove to be generally useful throughout our study of reasoning, and so are mentioned here: top-down, bottom-up and iteration.[16]

Top-down means get the big picture first, details later. In the computer programming context, it means thinking first about what you want your program to do, without worrying yet about how to do it. You break this down into a number of separate tasks, you break these down into subtasks, and so on. Eventually you have defined a number of small tasks, and it is easy to program them individually. Or so you hope.

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[15] Those beginning the study of logic have a fateful decision to make about the spelling of "premise". Many logicians, and others, use "premiss", but this is frowned on by such authorities as *The Oxford English Dictionary*, *The Gage Canadian Dictionary*, and Fowler's *Modern English Usage*, which says:

"The two ... spellings [premise(s) and premiss(es)] may perhaps be thought useful; but ambiguity cannot often arise between the parts of a SYLLOGISM ((*-isses*) and those of a parcel of real property (*ises*); and there is no reason for the variation. The two words are one, the parts of a syllogism being 'the previously stated', and the parts of the parcel of real property being 'the aforesaid' (buildings, land, etc., previously set out in the deed). The uniform spelling *premise* (pl. *premises*) is recommended."

The double 's' form is there because the word comes from the Latin *praemissa*, that which is put before. This word came into logic in the 12th century as a translation of the Arabic word *muqaddamah*, something put before, which had been used two centuries before to translate Aristotle's Greek *prótasis*. Before the Dark Ages, the Latin had been *propositio*.

[16] See, for example, G. Michael Schneider, and Steven C. Bruel, Advanced Programming and Problem Solving with Pascal. (New York: John Wiley & Sons, 1981), section 5.2 on structured programming.

Bottom-up, in programming, goes the other way. You start programming small tasks, and then you fit them together into the larger program.

Use hindsight early
and often.

The same ideas apply to writing an essay. Top-down means start with an outline, work on it until all the different parts of the essays have been identified, and the whole thing is organized and planned. Then you start writing. Bottom-up means start writing, and hope it will all come out right.

Teachers of computer programming and of writing tend to emphasize the top-down approach. Practitioners of these arts usually employ a combination of the methods.

What makes this all work is the third strategy, **iteration**. This means repetition, doing it over again. You do something to start with, find the flaws in what you have done, and do it again better. Do this over and over again - iterate. Or, to put is as a slogan: **Use hindsight early and often**[17]. Your first draft is never good enough.

We will be using these strategies constantly in our study of reasoning, and will frequently refer to them.

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[17] Michael Ham, "Structured Programming; Software Design Rules." Dr. Dobbs Journal of Software Tools, no. 129 (July, 1987), p. 113.